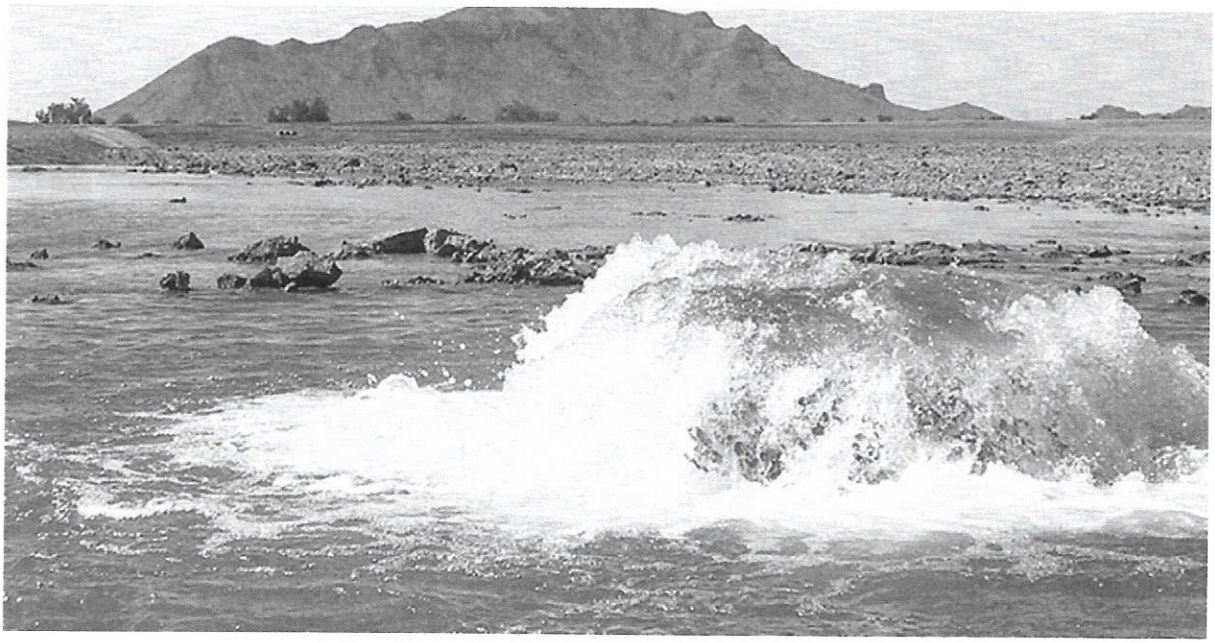
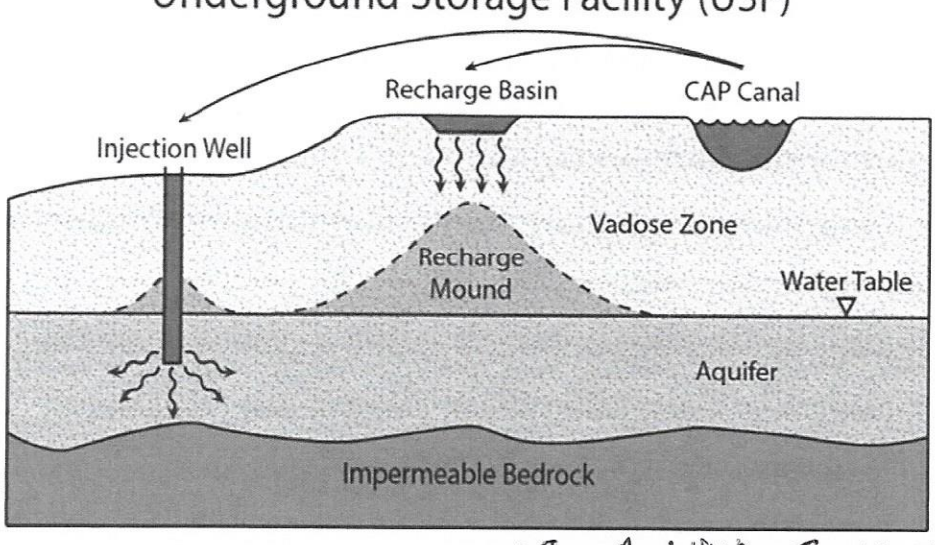
# Working Together: Arizona Water Leaders Prepare for Recovery Of "Banked" Water

***Published: May 25, 2021, www.azwater.gov***

Over two decades of often-severe drought… chronic instability on the Colorado Rivers system, particularly at Lake Mead… the uncertainties spawned by the prospect of a drier future overall for the Southwest…

It's time to start implementing…… The Plan.






For 25 years, the Arizona Water Banking Authority, or AWBA, has been storing water underground to protect against future shortages on the Colorado River. Now that the system may be facing shortage in 2022, the capability to recover this supply is more important than ever.

With the increasing likelihood of Colorado River shortages and the additional reductions required under the Lower Basin

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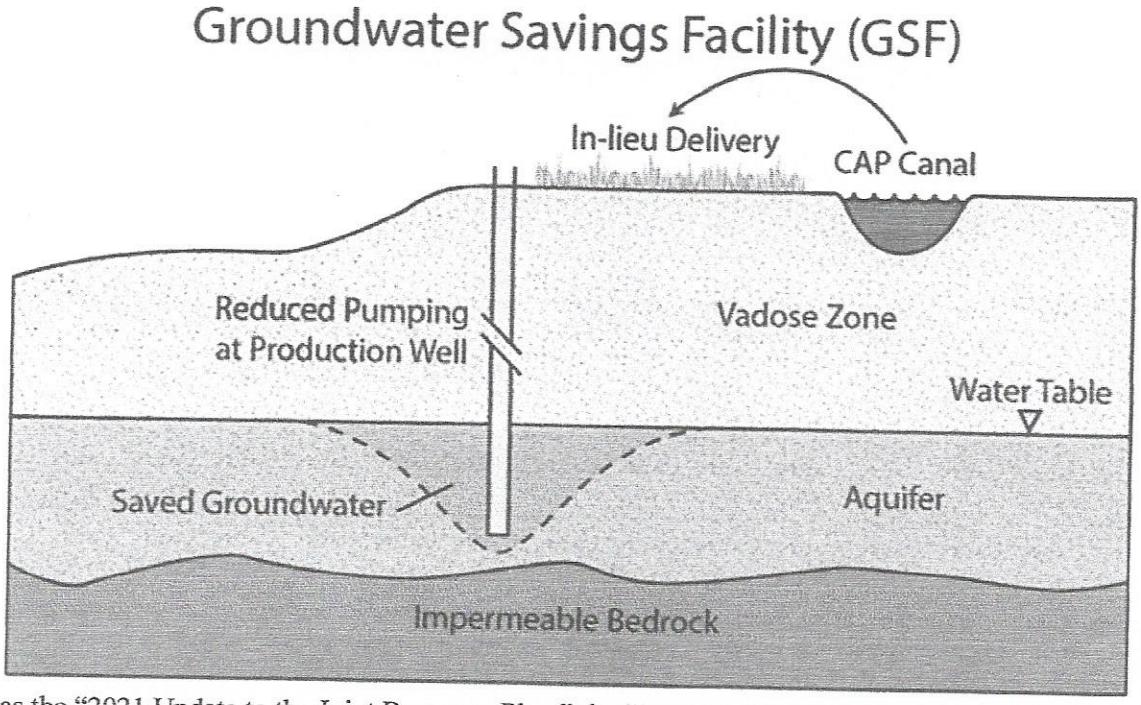
That advisory group (shorthand: "RPAG") sought to ensure that stakeholder perspectives are considered as recovery planning concepts are updated.

The contributions of RPAG members and other stakeholders played an important role in furthering the concepts reflected in the recently completed 2021 Update.

That update, the "Recovery of Water Stored by the Arizona Water Banking Authority: A Joint Plan by AWBA, ADWR and CAP" is now available online.




Officially known as the "2021 Update to the Joint Recovery Plan," the "2021 Update" serves as a companion document to an earlier version prepared in 2014. This latest edition expands on the earlier plan and provides further clarity on recovery implementation.

The 2014 Plan -- also a collaborative effort among the Water Bank, ADWR and CAP -- provides a roadmap for the recovery of Water Bank water-storage credits.

The 2021 Update includes a summary of recovery planning activities that have occurred since the completion of the 2014 Plan, an updated analysis of projected AWBA firming volumes, estimated recovery capacity needs and an updated operational timeline to further refine the procedural steps for recovery implementation.

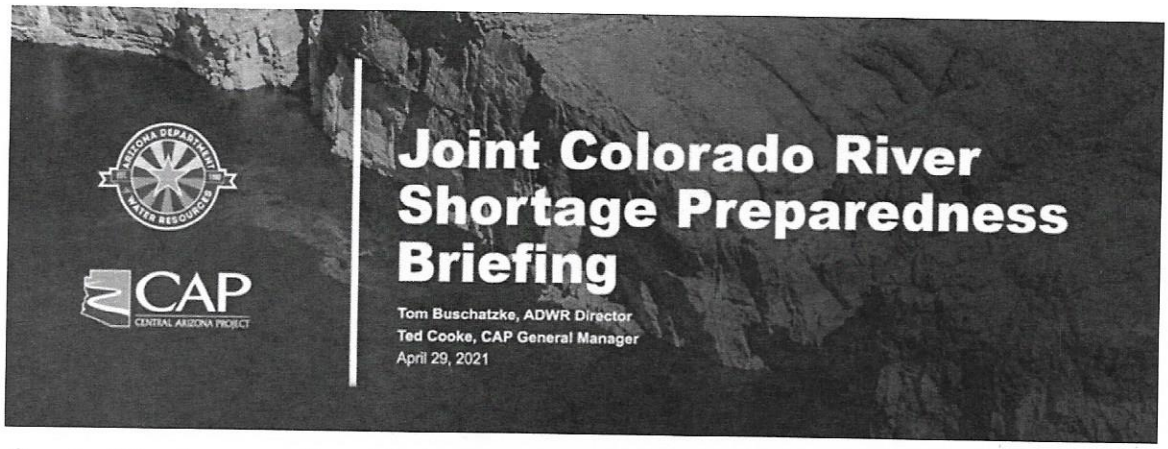
The AWBA itself has stored more than 4 million acre-feet of CAP-delivered water underground since its inception in 1996.

In total, nearly 12 million acre-feet of water have been stored underground in multiple locations around the State over the years. In addition to the Water Bank, entities storing that water include cities, tribes, and private organizations.

The highlights of the 2021 Update to the Joint Recover Plan are:

- Provides an analysis of projected Water Bank firming volumes and estimated recovery capacity needs
- Builds on previous planning efforts outlined in the 2014 plan
- Discusses recovery concepts intended to increase flexibility and fully use existing infrastructure
- Provides an updated operational timeline to further refine the procedural steps for recovery
- Identifies future activities and commitments by AWBA, ADWR and CAP

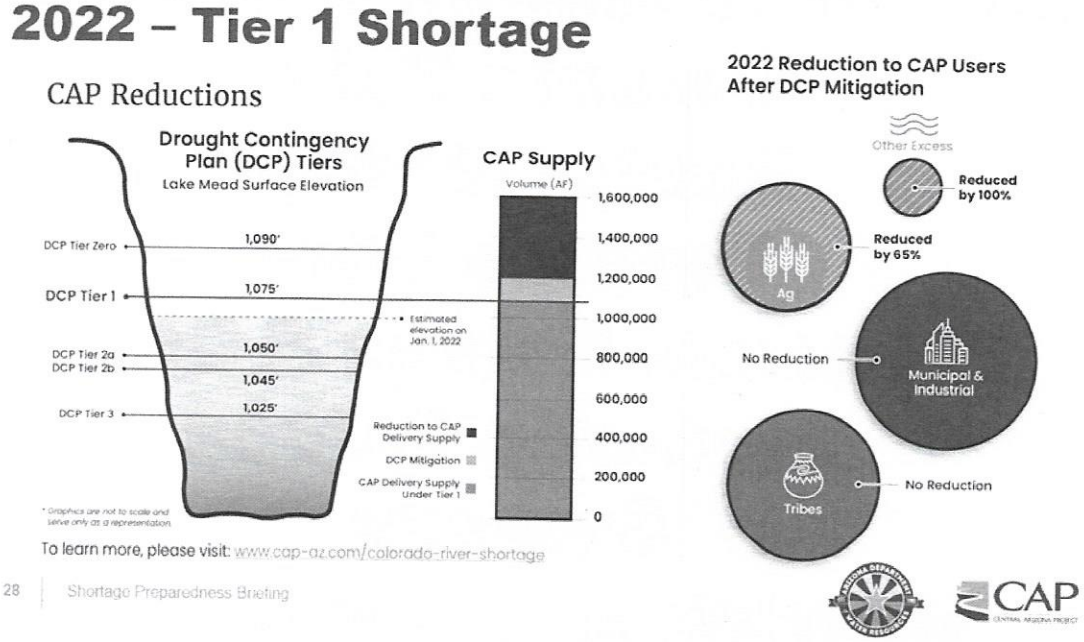
More information and links can be found at www.azwater.gov.




# Joint Colorado River Shortage Briefing Draws Hundreds Of Online Attendees

**Reprinted from azwater.gov/news**
**Published: May 6, 2021**

In an April 29 online briefing that attracted over 700 viewers, the Director of the Arizona Department of Water Resources and the General Manager of the Central Arizona Project described the unprecedented, drought-driven challenges facing the Colorado River system and what Arizona is doing to address them.




"The reason we're meeting today is that Lake Mead is 38 percent full," said CAP General Manager Ted Cooke. "And only five feet above the Tier 1 shortage trigger elevation."

As Cooke, ADWR Director Tom Buschatzke, and Dan Bunk of the Bureau of Reclamation would go on to explain, the low surface levels at Lake Mead almost certainly will trigger substantial cutbacks in Arizona's Colorado River deliveries beginning in 2022.

They also would explain, in detail, the decades-long effort by Arizona to prepare for those cuts.

Director Buschatzke observed that the system-wide efforts to stabilize Lake Mead – notably the 2019 Drought Contingency Plan – successfully helped forestall the reservoir's descent to dangerously low levels.

"DCP was not meant to eliminate the chance of shortage overall, explained the ADWR Director. "DCP is a success. We likely would already be in Tier 2 without the DCP."

The Lower Basin DCP is a set of shortage-sharing agreements among the Lower Basin States of Arizona, California and Nevada that adds to the shortage-sharing agreements put in place by the Colorado River states in 2007. In a process known as "reconsultation," the Bureau of Reclamation and the Basin States are preparing now for negotiations on a new set of operational rules that will take effect at the end of 2026.

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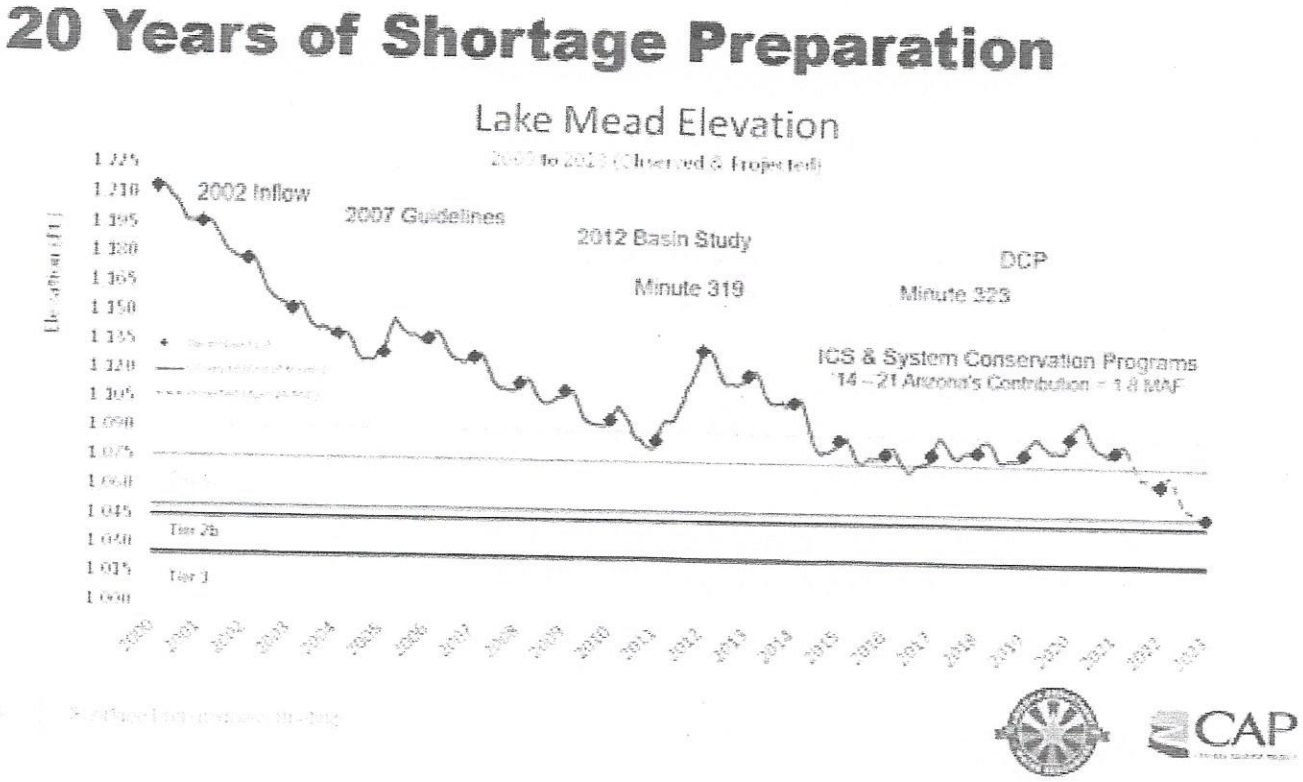
While the official shortage determination will not be made until August, the Bureau determined in April that a Tier 1 declaration for 2022 appeared likely. This will require Arizona to increase the amount of its annual allocation that it leaves in Lake Mead to a total of 512,000 acre-feet, again borne almost entirely by the CAP system.

The "Tier 1" reductions would constitute about 30 percent of CAP's normal supply; about 18 percent of Arizona's Colorado River supply; and less than 8 percent of Arizona's total water use.




Both Director Buschatzke and General Manager Cooke noted that most of those delivery cuts will impact agricultural water users in the CAP system. Despite mitigation efforts for those farmers, ag entities in impacted areas ultimately may have to reduce acreage by 30 to 40 percent, said Buschatzke.

Regarding urban areas, Buschatzke observed that city dwellers will not be affected by the cuts. However, the drought plans of individual communities may prompt them to initiate conservation efforts, he said. "There may be some cities who during the shortage decide, 'we may want to start preparing. The drought might last for another 20 years.' It's up to the cities to put into place those types of homeowner restrictions."

Buschatzke also noted that "we do a lot of planning. We have a lot of meetings. I would encourage people to follow those meetings closely.

"We want to hear what you have to say… we need folks to be educated about the real risks, the real challenges and where we have plans in place and actions in place that are going to minimize those risks."

To view a recording of the Apr. 29 Shortage Preparedness Briefing, go here:

- https://cap-az.granicus.com/player/clip/516?&redirect=true

To read a joint message prepared by ADWR and CAP on the drought and the anticipated Tier 1 shortage, go here:

- https://new.azwater.gov/sites/default/files/media/ADWR-CAP-ShortageStatement-final.pdf

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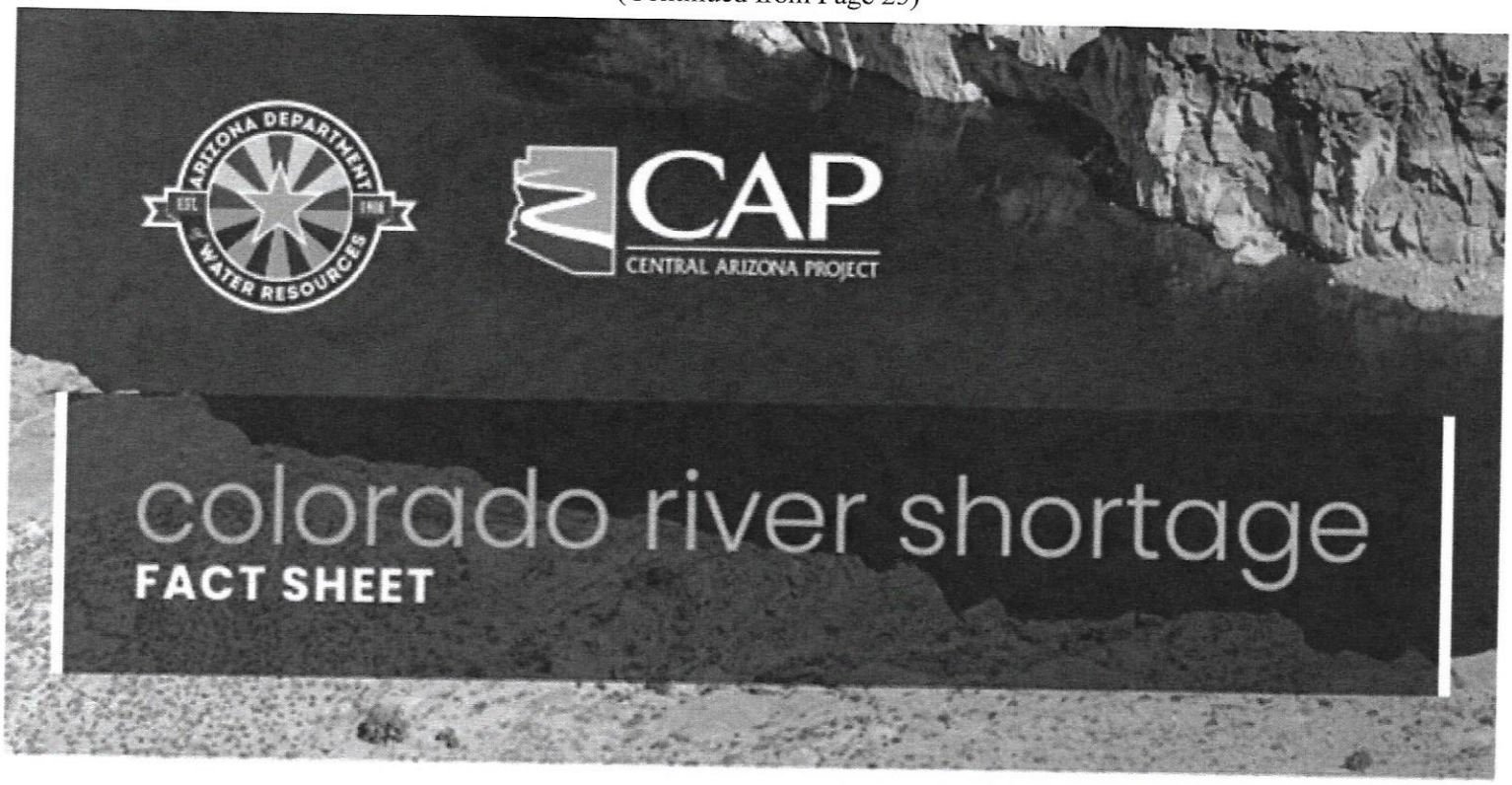


## ARIZONA – STRONGER TOGETHER

We anticipate the first-ever "Tier 1" shortage declaration on the Colorado River beginning in 2022. The shortage will result in a substantial cut to Arizona's share of the river, with reductions falling largely to central Arizona agricultural users. Water supplies for cities will not be affected and tribal supplies remain secure.

These reductions are painful, but we are prepared. We have long understood the risks to Arizona's Colorado River supplies and have been planning for decades, including the successful efforts to help craft the Drought Contingency Plan for the Colorado River system in 2019.

As we face the prospect of a hotter and drier future, we are confident that with our long history of successful collaboration among our diverse stakeholders – agriculture, tribes, cities, environment and industry – we will continue to find innovative and effective solutions to sustain Arizona's Colorado River supply.

## YOU SHOULD KNOW

- Arizona is prepared for a Colorado River shortage.
- Water interests from throughout the state worked collectively to share the risks and benefits of the Drought Contingency Plan (DCP).
- Together, these efforts reduce the pain of the near-term reductions while addressing risks of future shortages.
- We are taking steps and participating in partnerships to make the river more sustainable during drought and the reality of a hotter and drier future.

While we may have less water coming to Arizona from the Colorado River in 2022, Arizona's water managers and suppliers have been taking measures to prepare and will continue to work to ensure the river remains stable for generations to come.

## WHAT IS A COLORADO RIVER SHORTAGE?

A shortage means a reduction in the Colorado River supply available to Arizona.

In 2020 and 2021, the river has been operating in a "Tier Zero" status, requiring the State to forego 192,000 acre-feet of Arizona's 2.8-million acre-foot annual entitlement to Lake Mead. This reduction is coming entirely from the Central Arizona Project (CAP) system.

Based on the current hydrology, it is likely that the U.S. Bureau of Reclamation will announce a "Tier 1" shortage level for 2022. This will require Arizona to further reduce uses to a total of 512,000 acre-feet, again borne almost entirely by the CAP system.

The "Tier 1" reductions would constitute about 30% of CAP's normal supply, about 18% of Arizona's Colorado River supply, and less than 8% of Arizona's total water use.

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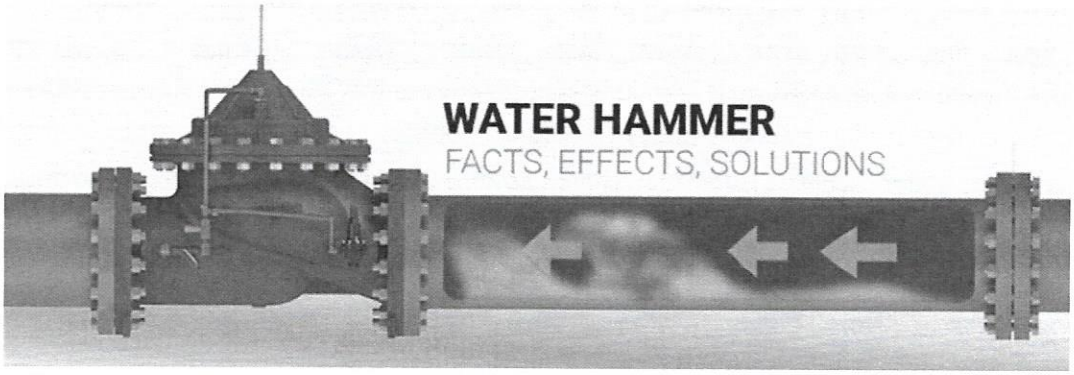
# Nail Down the Facts About Water Hammer




***Water hammer is a serious threat to the overall health and function of a pipeline system. The more you understand it, the easier it is to avoid.***

The clunking, thumping and banging sounds of water hammer in a pipeline system are not only annoying, but can very often be a sound that indicates costly repairs in the near future.

When the flow of a fluid is sharply stopped, a pressure wave is produced that travels through pipe systems. When a fluid is flowing in a certain direction it has momentum. When that momentum is suddenly obstructed the fluid will rapidly try to return to its normal condition, causing the fluid to travel back through the pipe and creating a shockwave. **These pressure spikes, known as water hammer or hydraulic shock, are common among household plumbing and large industrial treatment plants and can create enormous damage in a very short period of time.**

### When Does Water Hammer Occur?

On a **household scale**, this action can be created when running water to a shower, sink, dishwater or anything that causes water to steadily move through plumbing. When the water is shut off abruptly the pressure wave is created. Simply closing the valves slowly can eliminate this shockwave in these scenarios.

On a **larger scale like industrial treatment plants or municipal water system**, there are a few more things that can contribute to water hammer. In these systems, there are more factors that may reduce the flow of water enough to create a pressure wave. It can result from incorrect valve style or location, or from fluid pumps shutting off too quickly or unexpectedly.

### Effects of Water Hammer

Though **the outcomes of water hammer in a pipeline can vary, none of them are good for the system**. That loud banging sound associated with this occurrence is the sound of pressurized water slamming into a closed valve, plumbing joint or other blockage, like a fluid pump. Sometimes these forces can create pressure spikes that surpass five to 10 times a system's working pressure.

Repeated abuse from pressures that high on valves and joints can seriously damage them, causing leaks in joint gaskets, pressure gauges, flowmeters and all other components associated with the pipeline system. It has even been known to crack pipe walls and warp piping supports. Damage like this to any section of a pipeline system can be costly to repair and creates an unanticipated amount of downtime when the system isn't performing its intended purpose.

In many cases, water hammer is a safety concern. The extreme pressure can instantly blow out gaskets and explode pipes causing immediate danger to any person near the burst.

Eliminating or reducing water hammer starts with proper training. Ensure that operators know the importance of opening and closing shut-off valves slowly. Beyond that, making sure that the proper valves are in the correct locations throughout the pipeline system is the best way to reduce the potential for operator error.

### Can Water Hammer Be Calculated?

For the most part, **water hammer can be calculated.** However, there are many factors that play a role in determining the

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severity of the surge within a pipeline. Special considerations should be made to valve system applications with booster pump systems, water plants with a number of manifold pumps, long transmission lines, water well applications or hot-water closed systems.

For a quick and easy way to determine an approximate value, you can use a simple rule of thumb that for every 1 foot/second flow velocity change, you generate 54 psi of pressure surge above the normal system pressure in the pipeline.

**For example**, if you have a flow velocity of 10 feet/second and suddenly the water pump loses power, you will generate 540 psi of surge pressure above normal system pressure. If normal operating pressure was 100 psi, the surge pressure would be roughly 640 psi.

In systems with larger pumps a more accurate calculation should be done like in the example below. The images show how surge pressure waves are generated based on the closing speed of a valve based on an example using 1,000 feet of transmission pipeline. When closing the valve in 1/2 second, 1,450 psi is generated compared to closing the valve in 10 seconds when only a 130 psi surge is produced.

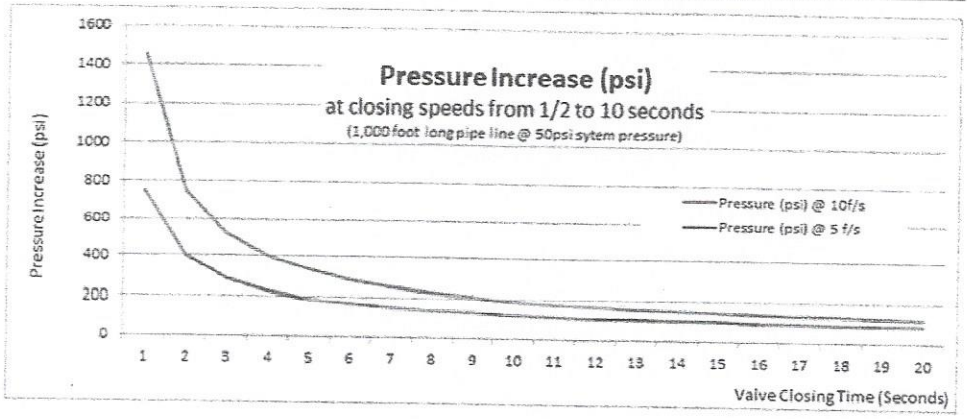
$$P = \frac{0.070VL}{t} + P_i$$

| | | |
|---|---|---|
| Flow Velocity (V): | 10 | Feet/second |
| Up-stream Pipe Length (L): | 1000 | Feet |
| Valve Closing Time (t): | 0.5 | Seconds |
| Inlet Pressure (Pi): | 50 | psi |
| **Solution - Pressure Increase (P): 1,450 PSI** | | |

| | | |
|---|---|---|
| Flow Velocity (V): | 5 | Feet/second |
| Up-stream Pipe Length (L): | 1000 | Feet |
| Valve Closing Time (t): | 10 | Seconds |
| Inlet Pressure (Pi): | 50 | psi |
| **Solution - Pressure Increase (P): 85 PSI** | | |

| Valve Closing Speed (Sec) | Pressure (psi) @ 10f/s |
|---|---|
| 0.5 | 1450.0 |
| 1 | 750.0 |
| 1.5 | 516.7 |
| 2 | 400.0 |
| 2.5 | 330.0 |
| 3 | 283.3 |
| 3.5 | 250.0 |
| 4 | 225.0 |
| 4.5 | 205.6 |
| 5 | 190.0 |
| 5.5 | 177.3 |
| 6 | 166.7 |
| 6.5 | 157.7 |
| 7 | 150.0 |
| 7.5 | 143.3 |
| 8 | 137.5 |
| 8.5 | 132.4 |
| 9 | 127.8 |
| 9.5 | 123.7 |
| 10 | 120.0 |

| Valve Closing Speed (Sec) | Pressure (psi) @ 5f/s | |
|---|---|---|
| 0.5 | 750.0 | -48.3% |
| 1 | 400.0 | -46.7% |
| 1.5 | 283.3 | -45.2% |
| 2 | 225.0 | -43.8% |
| 2.5 | 190.0 | -42.4% |
| 3 | 166.7 | -41.2% |
| 3.5 | 150.0 | -40.0% |
| 4 | 137.5 | -38.9% |
| 4.5 | 127.8 | -37.8% |
| 5 | 120.0 | -36.8% |
| 5.5 | 113.6 | -35.9% |
| 6 | 108.3 | -35.0% |
| 6.5 | 103.8 | -34.1% |
| 7 | 100.0 | -33.3% |
| 7.5 | 96.7 | -32.6% |
| 8 | 93.8 | -31.8% |
| 8.5 | 91.2 | -31.1% |
| 9 | 88.9 | -30.4% |
| 9.5 | 86.8 | -29.8% |
| 10 | 85.0 | -29.2% |




To help understand the amount of time that should be used when closing a valve to avoid critical damage, use the following equation provided below.

$$T_{cr} = \frac{2L}{a}$$

| | | |
|---|---|---|
| Length of Pipe Line (ft): | 1,000 | Feet |
| Pressure Wave Velocity (a): | 3,400 | Ft/second (Steel pipe) |
| **Solution - Critical Time $T_{er}$:** | **0.59** | Seconds |

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**It's All About the Valves**

Certain check valve styles are more susceptible to water hammer problems at higher flow velocities, like swing check valves and double door check valves that close very slowly without assisted closing functions to regulate closing time. While wafer style check valves and tilted disc check valves have controlled valve closing speeds for higher flow velocities and pressures. Any check valve that relies on backflow to close fully is at higher risk for creating a hydraulic shock, and when discs are pushed back onto the seat with too much force, it can damage the seal or change the alignment of the disc in seat causing leaking and failure. A resilient seated swing check valve with a field adjustable spring assisted closure should be considered, when there is a high risk of water hammer. This valve design was designed specifically to minimize the effects of water hammer.

The globe style silent check valve is a great choice over types of swing style valves in systems where water hammer is probable, as it is specifically engineered to reduce water hammer while preventing flow reversal. Silent check valves are internally spring loaded designed to close before reversal flow as the differential pressure decreases instead of closing from reverse flow. By closing due to a pressure decrease, it extremely unlikely that it will slam shut provoking water hammer. Hence the name "silent" check valve.

Globe style silent check valves get their name from their spherical valve body shape. The bulbous form is designed to allow less restrictive flow as fluid passes around the internal components of the valve. These silent check valves consist of two halves that are separated by an internal baffle. In an automated silent check valve, as fluid flows through, the pressure from the flow pushes the baffle off its seat, allowing it to pass through the valve. The baffle will slide along a smooth stem that is spring-loaded so it can reset back onto the seat as pressure drops and before fluid stops flowing. With a properly engineered valve with the correct spring tension in place, the valve closure starts as soon as the flow velocity drops, greatly reducing the chances of water hammer.

When pumping fluid into a tank through a short distance, check valves need to close very fast. In these situations, use the equation provided in the example below to determine the maximum surge pressure that will be generated and use that to choose the correct style check valve.

$$P_{surge\ water} = \frac{a\Delta V}{2.31g}$$

| | | |
|---|---|---|
| Pressure Wave Velocity Steel Pipe (a): | 3400 | Ft/second |
| Water Velocity Change (Δ V): | 10 | ft/second |
| Acceleration of Gravity (g): | 32.17 | ft/sec^2 |
| **Maximum Surge Presure ($P_{surge\ water}$)** | **457.5** | **psi** |

→ Note: The normal system pressure should be added.

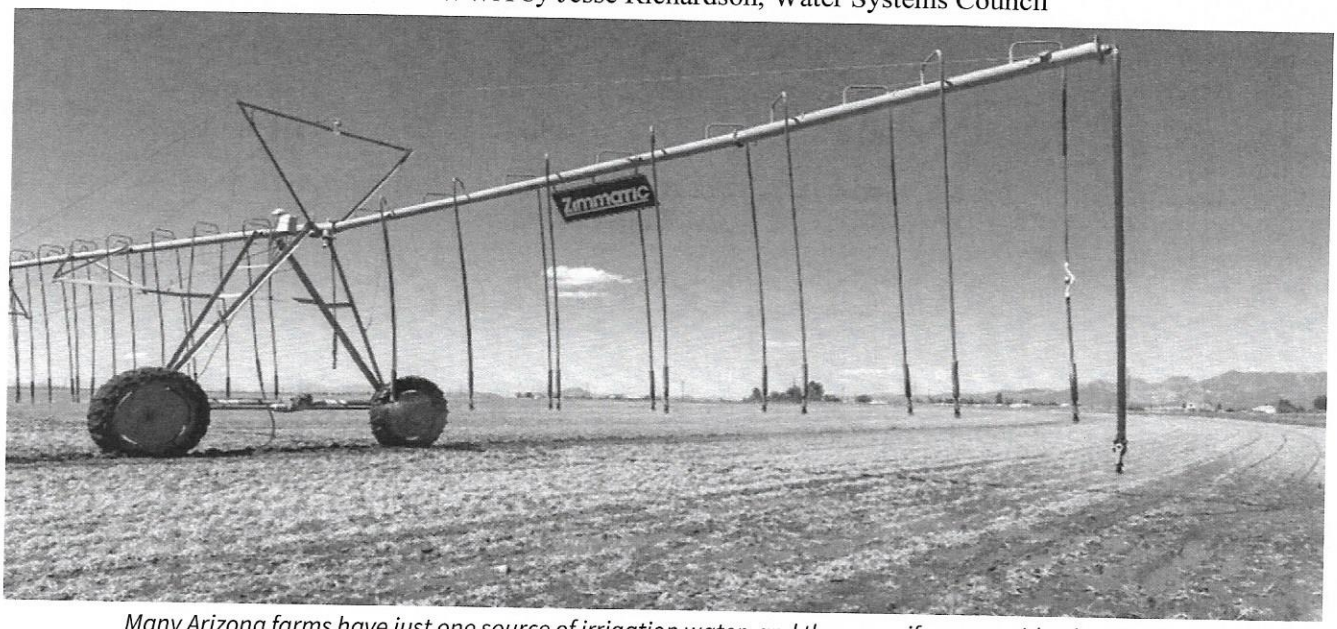
With the given example, it is best to use a wafer style check with a cracking pressure (opening pressure) of about 2 psi which will make the valve close faster. Wafer style silent check valves operate very similarly to globe style check valves but are smaller in overall dimension. They do not have the bulbous shape (except for Flomatic's new patented Model 888VFD), so they will impede flow slightly more than a globe style and have a slightly higher pressure drop. They are advantageous for fitting into tighter locations between two companion flanges where a flanged globe valve will not fit. This type fast closing valves are recommended for booster system in high rise buildings etc.

Flomatic makes an automatic hydraulic check valve for ultimate control in opening and closing speeds to reduce pressure surges and ensure smooth operation. When the upstream (inlet) pressure is greater than the downstream (outlet) pressure, the valve moves to the open position at a controlled speed by exhausting control water from the valves upper diaphragm area to the downstream side through an adjustable needle valve. When the upstream pressure becomes less than the downstream pressure, the valve closes to prevent reverse flow at a controlled speed by introducing control water above the diaphragm from the downstream side through a second adjustable needle valve. This type valve slow closing valves is recommended for longer pipe transmission lines.

There are options available to reduce or stop water hammer in your system. It's never too early to think about water hammer in a pipeline system, and it's never too late. Properly engineered systems should take it into account in the design phase and implement components and practices throughout building and operation to reduce water hammer as much as possible. It is a good idea to consult experts that have experience choosing the right valves and where to place them throughout the design process and during renovations. Simple valve replacements may be all it takes to get rid of the annoying sounds and safety hazards of water hammer.

# Should Population Shift Force New Colorado River Talks?

By Todd Fitchette | Farm Press Blog
Sent to AZWWA by Jesse Richardson, Water Systems Council




*Many Arizona farms have just one source of irrigation water, and those aquifers are said to be dwindling*

**Arizona farmers face curtailment of federal surface water while others worry their wells will be insufficient to sustain their operations.**

The wild, wild West of water is coming to a head and Arizona looks to be on the losing end.

Projections suggest that Lake Mead will be drawn down to its lowest level since Hoover Dam was completed, necessitating Tier 1 water restrictions by the end of the year. While Arizona and Nevada water users will see even greater cutbacks under the restrictions to their Colorado River allocations, California will maintain unfettered access to the massive water system.

For farmers with access to the federal Central Arizona Project, this means the irrigation taps will be turned off once Lake Mead falls to 1,075 feet in surface elevation. Results of the curtailment of surface water to central Arizona farms are predictable. Like their California neighbors facing similar water cuts, Arizona farms will either go without or face having to pump from dwindling aquifers. Unlike California, Arizona apparently does not have a groundwater law to force the sustainable balance of aquifers.

A farmer from southeast Arizona called me recently to ask if there was any truth to the rumors of $1,800 water costs in California, then proceeded to share how a neighboring agricultural operation with apparent deep pockets sunk a well that he fears will sink his livelihood.

Shocked as he was over the report that water is now trading for over $2,000 per acre foot in California, my farmer friend is more worried that domestic wells in his part of Arizona will be first to suffer as he learned the neighboring agricultural well was apparently drilled to 3,000 feet. Because he follows our publication and sees what is happening in California, he wonders if similar state legislation in Arizona could protect farmers from similar unsustainable groundwater pumping.

What happens to homeowners and small-acreage farmers in Arizona as investor farms move in with the capital sufficient to drill deep wells? Does this effectively do to parts of Arizona what the Dust Bowl did in the Plains states nearly 100 years ago? As more people leave California for Arizona, the need for water in the Grand Canyon State will continue to grow as the state boasts about enticing manufacturing jobs to Phoenix and Tucson and more people look to flee California.

Could Arizona residents face the same fate as Tulare County, Calif. residents who woke up one morning several years ago to find their taps had gone dry? Those domestic wells near Porterville, Calif. have never been repaired, according to a state assemblyman. Residents who cannot afford to leave these disadvantaged communities now live in third-world conditions just a few hours by car from billion-dollar start-up companies in the Silicon Valley.

Will the politically and socially disadvantaged communities of Arizona suffer a similar fate? What happens when politically connected cities in central Arizona see their own water supplies dwindle? Should water agreements that allow California greater access to the Colorado River than Arizona and Nevada be renegotiated? It seems logical given California's population decline and loss of a House seat in Congress.

Arizona residents can ill-afford the political games and can-kicking that have forced tens of thousands of people to flee California. Water is the lifeblood of human existence, and the West is at a dangerous crossroads of political inaction and urban attraction.